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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Nikoonahad et al.	§	Group Art Unit: 2877
	§	Examiner: Pham, H.
	§	Atty. Dkt. No.: 5589-02305
Serial No. 09/957,468	§	
Filed: September 20, 2001	§	I hereby certify that this correspondence is being transmitted via facsimile or deposited with the U.S. Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date indicated below:
For: METHODS AND SYSTEMS FOR DETERMINING A CRITICAL DIMENSION, A PRESENCE OF DEFECTS, AND A THIN FILM CHARACTERISTIC OF A SPECIMEN	§	12/01/2004 Date — Pamela Gerik (signature) Pamela Gerik

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir/Madam:

Further to the Notice of Appeal faxed October 1, 2004 and received in the Patent Office on October 1, 2004, Appellant presents this Appeal Brief. The Notice of Appeal was filed following mailing of a Final Office Action on August 3, 2004. Appellant hereby appeals to the Board of Patent Appeals and Interferences from a final rejection of claims 1413-1439, 1441-1445, 1447-1500, 1583, 1688, 1709, and 1751 in the Final Office Action mailed August 3, 2004, and respectfully requests that this appeal be considered by the Board.

I. REAL PARTY IN INTEREST

The subject application is owned by KLA-Tencor, Inc., a corporation having a place of business at 160 Rio Robles, San Jose, California 95134, as evidenced by the assignment recorded at reel 012651, frame 0815.

II. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-6632 were originally filed in the present application. Claims 1-1412, 1501-1582, 1584-1687, 1689-1708, 1710-1750, and 1752-6632 were cancelled in a Preliminary Amendment filed February 21, 2002. Claim 1446 was canceled in a response filed October 31, 2003 to an Office Action mailed July 31, 2003. Claims 1413, 1439-1442, 1445, 1478, 1500, 1583, 1688, 1709, and 1751 were amended in the same Office Action response. Claim 1440 was canceled in a response filed May 24, 2004 to an Office Action mailed February 23, 2004. Claims 1413, 1488, 1489, 1500, 1583, 1688, 1709, and 1751 were amended in the same Office Action response. A copy of claims 1413-1439, 1441-1445, 1447-1500, 1583, 1688, 1709, and 1751, as on appeal (incorporating entered amendments), is included in the Appendix hereto.

IV. STATUS OF AMENDMENTS

No amendments to the claims have been filed subsequent to their final rejection. The Appendix hereto therefore reflects the current state of the claims.

V. SUMMARY OF THE INVENTION

Appellant's claimed invention relates to a system (32, Fig. 3) configured to determine at least three properties of a specimen (40) during use. The system includes a stage (42) configured to support the specimen during use. The specimen includes a wafer (10, Fig. 1). The system also includes a measurement device (34, Fig. 3) coupled to the stage. The measurement device includes an illumination system (36) configured to direct energy toward a surface of the specimen during use. The measurement device also includes a detection system (38) coupled to the illumination system and configured to detect energy propagating from the surface of the specimen during use. The measurement device is configured to generate one or more output signals responsive to the detected energy during use. (Specification -- page 67, lines 12-21).

The system also includes a processor (54) coupled to the measurement device and configured to determine a first property, a second property, and a third property of the specimen from the one or more output signals during use. (Specification -- page 73, lines 9-15). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of the specimen. (Specification -- page 158, lines 4-14).

In one embodiment, the stage is configured to move laterally during use. (Specification -- page 257, lines 15-21). In a different embodiment, the stage is configured to move rotatably during use. (Specification -- page 64, lines 16-21). In other embodiments, the stage is configured to move laterally and rotatably during use. (Specification -- page 64, lines 21-22).

In some embodiments, the illumination system includes a single energy source (44, Fig. 3). (Specification -- page 67, line 23 - page 68, line 3). In other embodiments, the illumination system includes more than one energy source (44, Fig. 4). (Specification -- page 69, line 15 - page 70, line 2). In one embodiment, the detection system includes a single energy sensitive

device (46, Fig. 3). (Specification -- page 68, lines 5-12). In a different embodiment, the detection system includes more than one energy sensitive devices (46, Fig. 5). (Specification -- page 70, line 22 - page 71, line 8).

In a further embodiment, the measurement device includes a non-imaging scatterometer. (Specification -- page 87, line 26 - page 88, line 8). According to a different embodiment, the measurement device includes a scatterometer. In some embodiments, the measurement device includes a spectroscopic scatterometer. (Specification -- page 85, line 27 - page 87, line 24). The measurement device includes a reflectometer according to some embodiments. (Specification -- page 76, line 22 - page 78, line 12). In some embodiments, the measurement device includes a spectroscopic reflectometer. (Specification -- page 76, line 22 - page 78, line 12, page 191, line 2 - page 192, line 5). In other embodiments, the measurement device includes a coherence probe microscope. (Specification -- page 81, lines 5-9).

In one embodiment, the measurement device includes a bright field imaging device. (Specification -- page 88, line 10 - page 89, line 17). In another embodiment, the measurement device includes a dark field imaging device. (Specification -- page 89, line 19 - page 90, line 8). According to one embodiment, the measurement device includes a bright field and dark field imaging device. (Specification -- page 90, lines 10-25). In other embodiments, the measurement device includes a non-imaging bright field device. (Specification -- page 90, line 27 - page 91, line 3). In further embodiments, the measurement device includes a non-imaging dark field device. (Specification -- page 89, lines 26-27). In a different embodiment, the measurement device includes a non-imaging bright field and dark field device. (Specification -- page 90, line 27 - page 91, line 3).

In other embodiments, the measurement device includes an ellipsometer. In an additional embodiment, the measurement device includes a spectroscopic ellipsometer. (Specification -- page 139, line 22 - page 142, line 13). In another embodiment, the measurement device includes a dual beam spectrophotometer. In a different embodiment, the measurement device includes a beam profile ellipsometer. (Specification -- page 204, lines 5-11).

In some embodiments, the measurement device includes at least a first measurement device and a second measurement device. In one such embodiment, the first and second measurement devices are selected from the group consisting of a non-imaging scatterometer, a scatterometer, a spectroscopic scatterometer, a reflectometer, a spectroscopic reflectometer, a coherence probe microscope, a bright field imaging device, a dark field imaging device, a bright field and dark field imaging device, a non-imaging bright field device, a non-imaging dark field device, a non-imaging bright field and dark field device, an ellipsometer, a spectroscopic ellipsometer, a dual beam spectrophotometer, and a beam profile ellipsometer. (Specification -- page 150, lines 18-25). In another such embodiment, optical elements of the first measurement device include optical elements of the second measurement device. (Specification -- page 73, line 27 - page 74, line 1).

In one embodiment, the defects include micro defects and macro defects on the front side of the specimen. (Specification -- page 94, line 21 - page 96, line 22). In some embodiments, the thin film characteristic includes a thickness of a copper film. (Specification -- page 158, lines 8-9). In one such embodiment, the defects include voids in the copper film. (Specification -- page 152, lines 8-13). In other embodiments, the macro defects include copper contamination. (Specification -- page 158, lines 6-8).

In some embodiments, the processor is configured to determine a fourth property of the specimen from the one or more output signals during use. In some such embodiments, the fourth property is selected from the group consisting of a roughness of the specimen, a roughness of a layer on the specimen, and a roughness of a feature on the specimen. (Specification -- page 272, lines 7-17).

In another embodiment, the illumination system is configured to direct energy toward the back side of the specimen during use. The detection system is configured to detect energy propagating from the back side of the specimen during use in this embodiment. (Specification -- page 93, lines 1-9). In some embodiments, the illumination system and the detection system include non-optical components. (Specification -- page 68, lines 21-24). In one such

embodiment, the detected energy is responsive to a non-optical characteristic of the specimen. (Specification -- page 68, line 26 - page 69, line 3). In one embodiment, the measurement device includes at least an eddy current device and a spectroscopic ellipsometer. (Specification -- page 151, line 18 - page 152, line 23, page 181, line 17 - page 183, line 26). In one such embodiment, the system is coupled to an atomic layer deposition tool. (Specification -- page 184, lines 1-17).

The system may be configured to determine at least the three properties of the specimen substantially simultaneously during use in some embodiments. (Specification -- page 76, lines 17-18). In another embodiment, the illumination system is configured to direct energy to multiple locations on the surface of the specimen substantially simultaneously. The detection system may be configured to detect energy propagating from the multiple locations on the surface of the specimen substantially simultaneously such that the first, second, and third properties of the specimen at the multiple locations can be determined substantially simultaneously. (Specification -- page 66, lines 1-14).

In one embodiment, the system is coupled to a process tool. (Specification -- page 158, line 27 - page 159, line 18). In another embodiment, the system is coupled to a process tool selected from the group consisting of a lithography tool, an atomic layer deposition tool, a cleaning tool, and an etch tool. (Specification -- page 98, line 19 - page 103, line 13, page 184, lines 1-17, page 269, lines 1-21). In some embodiments, the system is coupled to a process tool, and, in one such embodiment, the system is disposed within the process tool. (Specification -- page 102, lines 17-23). In another such embodiment, the system is arranged laterally proximate to the process tool. (Specification -- page 102, lines 11-17). In a different such embodiment, the process tool includes a wafer handler configured to move the specimen to the stage during use. (Specification -- page 102, line 25 - page 103, line 1). In other such embodiments, the stage is configured to move the specimen from the system to the process tool during use. (Specification -- page 103, lines 1-2). In another such embodiment, the stage is configured to move the specimen to a process chamber of the process tool during use. (Specification -- page 103, lines 2-4). In yet another such embodiment, the system is configured to determine at least the three

properties of the specimen while the specimen is waiting between process steps. (Specification -- page 271, lines 2-16).

In some embodiments, the process tool includes a support device configured to support the specimen during a process step. (Specification -- page 111, lines 6-15). In one such embodiment, an upper surface of the support device is substantially parallel to an upper surface of the stage. (Specification -- page 111, lines 16-20). In a different embodiment, an upper surface of the stage is angled with respect to an upper surface of the support device. (Specification -- page 111, line 22 - page 112, line 2). In some embodiments, the process tool is selected from the group consisting of a lithography tool, an etch tool, and a deposition tool. (Specification -- page 142, line 15 - page 146, line 8, page 159, lines 20-24).

In one embodiment, the system includes a measurement chamber (178, Fig. 16). The stage and the measurement device may be disposed within the measurement chamber. (Specification -- page 108, line 11 - page 109, line 5). In one such embodiment, the measurement chamber is coupled to a process tool. (Specification -- page 109, lines 22-23). In another such embodiment, the measurement chamber is disposed within a process tool. (Specification -- page 109, lines 7-20). In a different embodiment, the measurement chamber (178, Fig. 17) is arranged laterally proximate to a process chamber (180) of a process tool. (Specification -- page 109, lines 23-24). In yet another embodiment, the measurement chamber is arranged vertically proximate to a process chamber of a process tool. (Specification -- page 109, lines 24-25).

In one embodiment, a process tool includes a process chamber (188, Fig. 18). (Specification -- page 112, lines 24-26). The stage (190) may be disposed within the process chamber. The stage may also be configured to support the specimen during a process step. (Specification -- page 112, lines 26-28). In one such embodiment, the processor may be configured to determine at least the three properties of the specimen during the process step. (Specification -- page 114, lines 13-16). In such an embodiment, the processor may be configured to obtain a signature characterizing the process step during use. The signature may include at least one singularity representative of an end of the process step. (Specification -- page

114, lines 16-20). In another such embodiment, the processor is coupled to the process tool and is configured to alter a parameter of one or more instruments coupled to the process tool in response to the determined properties using an in situ control technique during use. (Specification -- page 114, line 23 - page 115, line 2).

In some embodiments, a process tool includes a first process chamber and a second process chamber. The stage may be configured to move the specimen from the first process chamber to the second process chamber during use. In one such embodiment, the system is configured to determine at least the three properties of the specimen as the stage is moving the specimen from the first process chamber to the second process chamber. (Specification -- page 103, lines 4-10).

In one embodiment, the processor is configured to compare at least one of the determined properties of the specimen and properties of a plurality of specimens during use. (Specification -- page 116, lines 15-28). In another embodiment, the processor is configured to compare at least one of the determined properties of the specimen to a predetermined range for the property during use. (Specification -- page 117, lines 2-7). In one such embodiment, the processor is configured to generate an output signal if at least one of the determined properties of the specimen is outside of the predetermined range for the property during use. (Specification -- page 117, lines 8-13).

In some embodiments, the processor is configured to alter a sampling frequency of the measurement device in response to at least one of the determined properties of the specimen during use. (Specification -- page 118, lines 4-16). In another embodiment, the processor is configured to alter a parameter of one or more instruments coupled to the measurement device in response to at least one of the determined properties using a feedback control technique during use. (Specification -- page 119, lines 1-11). In a different embodiment, the processor is configured to alter a parameter of one or more instruments coupled to the measurement device in response to at least one of the determined properties using a feedforward control technique during use. (Specification -- page 118, lines 18-26).

In one embodiment, the processor is configured to generate a database during use. (Specification -- page 119, line 13). The database includes the determined first, second, and third properties of the specimen. (Specification -- page 119, lines 14-15). The processor may be configured to calibrate the measurement device using the database during use. (Specification -- page 119, lines 15-25). In another embodiment, the processor is configured to monitor output signals generated by the measurement device using the database during use. (Specification -- page 119, line 27 - page 120, line 5). In a different embodiment, the database also includes first, second, and third properties of a plurality of specimens. (Specification -- page 120, lines 5-7). The first, second, and third properties of the plurality of specimens may be determined using the measurement device. Alternatively, the first, second, and third properties of the plurality of specimens may be determined using a plurality of measurement devices. (Specification -- page 120, lines 9-11). The processor may be coupled to the plurality of measurement devices. (Specification -- page 120, lines 11-12). In addition, the processor may be configured to calibrate the plurality of measurement devices using the database during use. (Specification -- page 120, lines 12-14). The processor may also be configured to monitor output signals generated by the plurality of measurement devices using the database during use. (Specification -- page 120, lines 14-15).

In some embodiments, the system may include a stand alone system coupled to the system. (Specification -- page 267, lines 19-24). The stand alone system may be configured to be calibrated with a calibration standard during use. (Specification -- page 267, lines 25-27). The stand alone system may also be configured to calibrate the system during use. (Specification -- page 267, line 27 - page 268, line 2). In another embodiment, the system includes a stand alone system coupled to the system and at least one additional system. (Specification -- page 268, lines 4-14). The stand alone system may be configured to be calibrated with a calibration standard during use. The stand alone system may also be configured to calibrate the system and at least the one additional system during use. (Specification -- page 268, lines 16-26).

In one embodiment, the system is configured to determine at least the three properties of the specimen at more than one position on the specimen. The processor may be configured to

alter at least one parameter of one or more instruments coupled to a process tool in response to at least one of the determined properties of the specimen at the more than one position on the specimen to reduce within wafer variation of at least one of the determined properties. (Specification -- page 245, line 27 - page 249, line 25).

In another embodiment, the processor is coupled to a process tool. In one such embodiment, the processor is configured to alter a parameter of one or more instruments coupled to the process tool in response to at least one of the determined properties using a feedback control technique during use. (Specification -- page 115, line 27 - page 116, line 1, page 116, lines 3-7). In another such embodiment, the processor is configured to alter a parameter of one or more instruments coupled to the process tool in response to at least one of the determined properties using a feedforward control technique during use. (Specification -- page 116, lines 1-3 and 7-13). In a different such embodiment, the processor is configured to monitor a parameter of one or more instruments coupled to the process tool during use. (Specification -- page 115, lines 4-15). In such an embodiment, the processor may be configured to determine a relationship between at least one of the determined properties and at least one of the monitored parameters during use. The processor may also be configured to alter a parameter of at least one of the instruments in response to the relationship during use. (Specification -- page 115, lines 15-20).

In an additional embodiment, the processor is coupled to a plurality of measurement devices. (Specification -- page 120, lines 17-18). Each of the plurality of measurement devices is coupled to at least one of a plurality of process tools. (Specification -- page 120, lines 21-22). In some embodiments, the processor includes a local processor coupled to the measurement device and a remote controller computer coupled to the local processor. (Specification -- 121, lines 5-7). The local processor is configured to at least partially process the one or more output signals during use. (Specification -- page 121, lines 7-13). The remote controller computer is configured to further process the at least partially processed one or more output signals during use. (Specification -- page 121, lines 13-14). In some embodiments, the local processor may also be configured to determine the first, second, and third properties of the specimen during use.

(Specification -- page 121, lines 14-21). In other embodiments, the remote controller computer may be configured to determine the first, second, and third properties of the specimen during use.

Appellant's claimed invention also relates to a method for determining at least three properties of a specimen. (Specification -- page 122, lines 8-9). The method includes disposing the specimen upon a stage (196, Fig. 19). The specimen includes a wafer. The stage is coupled to a measurement device. (Specification -- page 122, lines 9-11). The measurement device includes an illumination system and a detection system. (Specification -- page 122, lines 11-12). The method also includes directing energy toward a surface of the specimen using the illumination system (198) and detecting energy propagating from the surface of the specimen using the detection system (200). (Specification -- page 122, lines 12-15). In addition, the method includes generating one or more output signals responsive to the detected energy. The method further includes processing the one or more output signals to determine a first property, a second property, and a third property of the specimen (202). (Specification -- page 122, lines 15-17). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of the specimen. (Specification -- page 158, lines 4-14).

Appellant's claimed invention further relates to a computer-implemented method for controlling a system configured to determine at least three properties of a specimen during use. The system includes a measurement device. The computer-implemented method includes controlling the measurement device (212, Fig. 21). The measurement device includes an illumination system and a detection system. The measurement device is coupled to a stage. (Specification -- page 134, lines 21-26). Controlling the measurement device includes controlling the illumination system to direct energy toward a surface of the specimen (214). The specimen includes a wafer. (Specification -- page 134, lines 26-28). Controlling the measurement device also includes controlling the detection system to detect energy propagating

from the surface of the specimen (216) and generating one or more output signals in response to the detected energy. (Specification -- page 134, line 28 - page 135, line 2).

The computer-implemented method also includes processing the one or more output signals to determine a first property, a second property, and a third property of the specimen (218). (Specification -- page 135, lines 2-4). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of the specimen. (Specification -- page 158, lines 4-14).

Appellant's claimed invention also relates to a method for fabricating a semiconductor device. The method includes forming a portion of the semiconductor device upon a specimen (204, Fig. 19). The specimen includes a wafer. (Specification -- page 133, line 26 - page 134, line 8). The method also includes disposing the specimen upon a stage (196). (Specification -- page 134, lines 10-11). The stage is coupled to a measurement device. The measurement device includes an illumination system and a detection system. In addition, the method includes directing energy toward a surface of the specimen using the illumination system (198) and detecting energy propagating from the surface of the specimen using the detection system (200). (Specification -- page 134, lines 11-15). The method further includes generating one or more output signals responsive to the detected energy. The method also includes processing the one or more output signals to determine a first property, a second property, and a third property of the specimen (202). (Specification -- page 134, lines 15-19). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of a portion of the specimen. (Specification -- page 158, lines 4-14).

Appellant's claimed invention further relates to a system (32, Fig. 3) configured to determine at least three properties of a specimen (40) during use. This system includes a stage (42) configured to support the specimen during use. The specimen includes a wafer (10, Fig. 1). The system also includes a measurement device (34, Fig.3) coupled to the stage. The measurement device includes an illumination system (36) configured to direct energy toward a surface of the specimen during use. The measurement device also includes a detection system (38) coupled to the illumination system and configured to detect energy propagating from the surface of the specimen during use. The measurement device is configured to generate one or more output signals responsive to the detected energy during use. (Specification -- page 67, lines 12-21).

The system also includes a local processor coupled to the measurement device and configured to at least partially process the one or more output signals during use. In addition, the system includes a remote controller computer coupled to the local processor. (Specification -- page 121, lines 5-7). The remote controller computer is configured to receive the at least partially processed one or more output signals and to determine a first property, a second property, and a third property of the specimen from the at least partially processed one or more output signals during use. (Specification -- page 121, lines 7-21). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of the specimen. (Specification -- page 158, lines 4-14).

Appellant's claimed invention also relates to a method for determining at least three properties of a specimen. (Specification -- page 122, lines 8-9). The method includes disposing the specimen upon a stage (196, Fig. 19). The specimen includes a wafer. The stage is coupled to a measurement device. (Specification -- page 122, lines 9-11). The measurement device includes an illumination system and a detection system. (Specification -- page 122, lines 11-12). The method also includes directing energy toward a surface of the specimen using the

illumination system (198) and detecting energy propagating from the surface of the specimen using the detection system (200). (Specification -- page 122, lines 12-15). In addition, the method includes generating one or more output signals responsive to the detected energy.

The method further includes processing the one or more output signals to determine a first property, a second property, and a third property of the specimen (202). (Specification -- page 122, lines 15-17). The first property includes a critical dimension of the specimen. (Specification -- page 74, line 10 - page 75, line 9, page 150, lines 7-9). The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. (Specification -- page 93, lines 16-19). The third property includes a thin film characteristic of the specimen. (Specification -- page 158, lines 4-14).

Processing the one or more output signals includes at least partially processing the one or more output signals using a local processor (206, Fig. 20). The local processor is coupled to the measurement device. (Specification -- page 153, lines 7-9). Processing the one or more output signals also includes sending the partially processed one or more output signals from the local processor to a remote controller computer (208). (Specification -- page 153, lines 9-11). In addition, processing the one or more output signals includes further processing the partially processed one or more output signals using the remote controller computer (210). (Specification -- page 153, lines 11-24).

VI. ISSUES

1. Whether claims 1413-1420, 1424, 1433, 1436-1438, 1443, 1450-1451, 1478-1482, 1487-1488, 1500, 1583, and 1688 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 5,748,318 to Maris et al. (hereinafter "Maris") in view of U.S. Patent No. 4,468,120 to Tanimoto et al. (hereinafter "Tanimoto").

2. Whether claims 1421-1423, 1425-1432, 1434-1435, 1439-1442, 1444, 1445, 1447-1449, 1452-1477, 1483-1486, 1489-1499, 1709, and 1751 are unpatentable under 35 U.S.C. §

103(a) over Maris in view of Tanimoto and further in view of U.S. Patent No. 5,872,632 to Moore (hereinafter "Moore") and U.S. Patent No. 4,865,445 to Kuriyama et al. (hereinafter "Kuriyama"). (Claim 1440 was canceled as noted above, thereby rendering its rejection moot.)

VII. GROUPING OF CLAIMS

Claims 1413-1414, 1417-1420, 1424, 1433, 1437-1438, 1443, 1450, 1500, 1583, and 1688 (Group I) stand or fall together.

Claims 1415-1416 (Group II) stand or fall together.

Claims 1421-1423 (Group III) stand or fall together.

Claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, 1497-1499, 1709, and 1751 (Group IV) stand or fall together.

Claim 1426 (Group V) stands or falls alone.

Claim 1435 (Group VI) stands or falls alone.

Claim 1436 (Group VII) stands or falls alone.

Claim 1442 (Group VIII) stands or falls alone.

Claims 1448-1449 (Group IX) stand or fall together.

Claim 1451 (Group X) stands or falls alone.

Claims 1456-1457 (Group XI) stand or fall together.

Claim 1458 (Group XII) stands or falls alone.

Claim 1460 (Group XIII) stands or falls alone.

Claims 1466-1469 (Group XIV) stand or fall together.

Claims 1470-1471 (Group XV) stand or fall together.

Claims 1472-1474 (Group XVI) stand or fall together.

Claims 1478-1482 (Group XVII) stand or fall together.

Claims 1483-1486 (Group XVIII) stand or fall together.

Claims 1487-1488 (Group XIX) stand or fall together.

Claim 1489 (Group XX) stands or falls alone.

Claim 1496 (Group XXI) stands or falls alone.

The reasons why the twenty one groups of claims are believed to be separately patentable are explained below in the appropriate parts of the Argument.

VIII. ARGUMENT

Fabrication of semiconductor devices such as logic and memory devices typically includes a number of processes that are used to form various features and multiple levels or layers of semiconductor devices on a surface of a semiconductor wafer or another appropriate substrate. After processing is complete, the semiconductor wafer is separated into individual semiconductor devices. *See* Specification: page 1, lines 18-28.

Semiconductor fabrication processes are among the most sophisticated and complex processes used in manufacturing. In order to perform efficiently, semiconductor fabrication processes require frequent monitoring and careful evaluation. For example, extensive monitoring and evaluation of semiconductor fabrication processes is typically performed to ensure that the processes are within design tolerance and to increase the overall yield of the processes. Ideally, extensive monitoring and evaluation of the processes takes place both during process development and during process control of semiconductor fabrication processes. *See* Specification: page 2, lines 2-15. In addition, as feature sizes of semiconductor devices continue to shrink, a minimum feature size that may be fabricated may often be limited by the performance characteristics of a semiconductor fabrication process. As such, controlling the parameters of processes that may be critical to the resolution capability of a semiconductor fabrication process such as a lithography process is becoming increasingly important to the successful fabrication of semiconductor devices. *See* Specification: page 2, line 17 to page 3, line 2.

There are several disadvantages, however, in using the currently available methods and systems for metrology and/or inspection of specimens fabricated by semiconductor fabrication processes. For example, multiple stand-alone metrology/inspection systems may be used for metrology and/or inspection of specimens fabricated by such processes. As used herein, the term

"stand-alone metrology/inspection system" generally refers to a system that is not coupled to a process tool and is operated independently of any other process tools and/or metrology/inspection systems. Multiple metrology/inspection systems occupy a relatively large amount of clean room space due to the footprints of each of the metrology and/or inspection systems. *See* Specification: page 3, lines 4-17.

In addition, testing time and process delays associated with measuring and/or inspecting a specimen with multiple systems increase the overall cost of manufacturing and the manufacturing time for fabricating a semiconductor device. For example, process tools may often be idle while metrology and/or inspection of a specimen is performed such that the process may be evaluated before additional specimens are processed thereby increasing manufacturing delays. Furthermore, if processing problems cannot be detected before additional wafers have been processed, wafers processed during this time may need to be scrapped, which increases the overall cost of manufacturing. Additionally, buying multiple metrology/inspection systems increases the cost of fabrication. *See* Specification: page 3, lines 19-28.

In an additional example, for in situ metrology and/or inspection using multiple systems, determining a characteristic of a specimen during a process may be difficult if not impossible. For example, measuring and/or inspecting a specimen with multiple systems during a lithography process may introduce a delay time between or after process steps of the process. If the delay time is relatively long, the performance of the resist may be adversely affected, and the overall yield of semiconductor devices may be reduced. As such, there may also be limitations on process enhancement, control, and yield of semiconductor fabrication processes due to the limitations associated with metrology and/or inspection using multiple systems. Process enhancement, control, and yield may also be limited by an increased potential for contamination associated with metrology and/or inspection using multiple systems. In addition, there may be practical limits in using multiple metrology/inspection systems in semiconductor manufacturing processes. In an example, for in situ metrology and/or inspection using multiple systems, integrating the systems into a process tool or a cluster tool may be difficult due to the availability of space within the tool. *See* Specification: page 4, lines 2-18.

The invention as recited in claims 1413-1439, 1441-1445, 1447-1500, 1583, 1688, 1709, and 1751 addresses the above-described problems by providing systems and methods for determining at least three properties of a specimen. The first property includes a critical dimension of the specimen. The second property includes a presence of defects on the specimen. The defects include macro defects on a back side of the specimen and micro or macro defects on a front side of the specimen. The third property includes a thin film characteristic of the specimen. *See* Specification: page 150, lines 7-27. Therefore, one system can be used to provide substantially more information about a specimen than currently available metrology/inspection systems.

The presently claimed systems and methods provide a number of additional advantages over other systems and methods. For example, the presently claimed systems may include multiple measurement devices configured to generate output signals that can be used to determine these properties of a specimen. Because multiple measurement devices may be integrated into a single system, optical elements of a first measurement device, for example, may also be used as optical elements of a second measurement device. In addition, multiple measurement devices may be coupled to a common stage, a common handler, and a common processor. The system may also be configured to determine a critical dimension, a presence of defects, and a thin film characteristic of a specimen sequentially or substantially simultaneously. In this manner, such a system may be more cost, time, and space efficient than systems currently used in the semiconductor industry. *See* Specification: page 73, line 27 to page 74, line 8.

The presently claimed systems may also be coupled to a semiconductor fabrication tool. Because the systems may be coupled to a semiconductor fabrication process tool such as a lithography tool, properties of a specimen may be determined faster than stand alone metrology and inspection tools. Therefore, a system, as described herein, may reduce the turn-around-time for determining properties of a specimen. A reduced turn-around-time may provide significant advantages for process control. For example, a reduced turn-around-time may provide tighter process control of a semiconductor fabrication process than stand alone metrology and inspection

tools. Tighter process control may provide, for instance, a reduced variance in critical dimension distributions of features on a specimen. *See* Specification: page 106, lines 16-24.

A process tool may include a support device that is configured to support a specimen during a process step. An upper surface of a stage of the presently claimed systems may be angled with respect to an upper surface of the support device. An angled orientation of the stage within a measurement chamber of the system may allow a lateral dimension of the measurement chamber to be reduced. For example, the illumination system, the detection system, and the stage may be arranged in a more compact geometry than conventional inspection and metrology systems. In particular, a lateral dimension of a measurement chamber may be greatly reduced for relatively large diameter specimens such as 200 mm wafers and 300 mm wafers. As such, disposing such a measurement device within a semiconductor fabrication process tool may be less likely to require retrofitting of the process tool. Therefore, existing configurations of semiconductor fabrication process tools may be less likely to prohibit disposing the system within the process tool. *See* Specification: page 111, lines 13-22.

The presently claimed systems may also be configured to perform field level analysis of a specimen. A system configured to evaluate and control a process using field level analysis may provide dramatic improvements over current process control methods. For example, measuring within wafer variability of properties may provide tighter control of the properties' distribution. In addition to improving the manufacturing yield, therefore, the presently claimed methods and systems may also enable a manufacturing process to locate the distribution performance of manufactured devices closer to a higher performance level. As such, the high margin product yield may also be improved by using such a method to evaluate and control a process. Furthermore, additional variations in the process may also be minimized. For example, a process may use two different, but substantially similarly configured process chambers, to process one lot of specimens. Two process chambers may be used to perform the same process such that two specimens may be processed simultaneously in order to reduce the overall processing time. Therefore, the presently claimed systems and methods may be used to evaluate and control each

process chamber separately. As such, the overall process spread may also be reduced. *See* Specification: page 248, lines 1-14.

ISSUE 1 ARGUMENTS

A. Patentability of Group I Claims 1413-1414, 1417-1420, 1424, 1433, 1437-1438, 1443, 1450, 1500, 1583, and 1688

1. The cited art does not teach or suggest a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer.

Independent claim 1413 recites in part: "A system configured to determine at least three properties of a specimen during use,...wherein the second property comprises a presence of defects on the specimen, wherein the defects comprise macro defects on a back side of the specimen, wherein the defects further comprise micro defects or macro defects on a front side of the specimen, wherein the specimen comprises a wafer." Independent claims 1500, 1583, and 1688 recite similar limitations.

Maris discloses an optical stress generator and detector. Maris, however, does not teach or suggest a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer. For example, Maris states that "the physical properties of the sample 51 which may be determined in this way include...interfacial contaminants." (Maris -- col. 9, line 66 - col. 10, line 6). Therefore, Maris discloses detecting defects at an interface between two layers or between a layer and a substrate. However, Maris does not disclose detecting defects on a back side of a wafer (i.e., a side of a wafer on which semiconductor devices will not be or are not formed). As such, Maris does not teach or suggest a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer, as recited in claims 1413,

1500, 1583, and 1688. Therefore, Maris does not teach or suggest all limitations of claims 1413, 1500, 1583, and 1688.

In addition, Maris cannot be combined with Tanimoto to overcome the deficiencies therein. For example, Tanimoto discloses a foreign substance inspecting apparatus. Tanimoto, however, does not disclose a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer. The Final Office Action mailed August 3, 2004 (PTO Paper No. 0704) states that "Applicant's remarks, pages 18-19, argue that Tanimoto cannot detect defects on two sides of an opaque specimen such as wafer. The argument is not deemed to be persuasive because: (1) the present claimed invention does not recite an **opaque specimen**, claims must be examined on the basic of what they say, absent limitation may not be considered to be present." (Final Office Action -- page 7). However, the teachings of Tanimoto must be considered in light of the inherent properties of the claimed wafer, which are consistent with the disclosure of the specification and the teachings of the prior art. "In determining whether the invention as a whole would have been obvious under 35 U.S.C. 103, we must first delineate the invention as a whole. In delineating the invention as a whole, we look not only to the subject matter which is literally recited in the claim in question...but also to those properties of the subject matter which are inherent in the subject matter *and* are disclosed in the specification..." *In re Antonie*, 559 F.2d 618, 620, 195 USPQ 6,8 (CCPA 1977) (emphasis in original). MPEP 2141.02. A wafer is described in the Specification, for example, on page 63, lines 6-27.

The prior art also discloses the inherent properties of a wafer. For example, Maris discloses that the light of the prior art systems will be absorbed by a wafer unless the systems are configured to use light having a wavelength of greater than 1 micron. In particular, Maris states:

> For many samples of current interest in the semiconductor circuit fabrication industry it is not practical to measure the change ΔT in the transmission of the probe light pulse. The films are normally deposited onto silicon substrates of thickness around 0.02 cm. Unless light of wavelength of one micron or greater is used, the light will be heavily absorbed in the substrate making the measurement of the transmission very difficult. For such samples conventional methods are thus essentially limited to the use of measurement of

the change ΔR in the optical reflectivity induced by the pump pulse. (Maris -- col. 27, lines 65 - col. 28, line 8).

However, Tanimoto does not teach or suggest using light having a wavelength of one micron or greater. In addition, for at least the reasons set forth below, the cited art provides no suggestion that the systems of Tanimoto can be modified to detect defects on a back side and a front side of the presently claimed wafer.

In particular, Tanimoto states that "the laser light 1 obliquely incident on a pattern surface S_1 having a light-intercepting layer 5b applied to the glass substrate 5a of the photomask 5 is regularly reflected by the glass substrate 5a." (Tanimoto -- col. 7, lines 15-18). Therefore, Tanimoto discloses that the laser light is directed at surface S_1 of photomask 5, as shown in Fig. 4 of Tanimoto. Tanimoto also states that "a light-receiving portion B...is opposed to the surface S_2 of the glass substrate 5a opposite to the pattern surface S_1. This light-receiving portion B...obliquely looks to the portion irradiated with the laser light 1 from the surface S_2 side." (Tanimoto -- col. 7, lines 32-40). Therefore, Tanimoto discloses that light-receiving portion B detects light passed through the glass substrate, as shown in Fig. 4 of Tanimoto. As such, Tanimoto detects defects on one side of the glass substrate by detecting light that has passed through the substrate and is irregularly reflected or scattered by defects on this one side.

Tanimoto does not disclose any particular wavelength for laser light 1. Since glass substrates will transmit wavelengths of light conventionally used in inspection systems, Tanimoto may have been largely unconcerned with the selection of a particular wavelength for laser light 1. However, glass substrates have dramatically different transmission properties compared to the presently claimed wafer. Therefore, in order to use the system of Tanimoto to detect defects on two sides of a wafer (by detecting light transmitted through a substrate as taught by Tanimoto), the wavelength of laser light 1 must be carefully selected. For example, as discussed by Maris, when attempting to make transmission measurements on wafers, the selection of a particular wavelength to be used for the measurements becomes significant.

However, even if the systems of Tanimoto are modified such that the laser light includes infrared light to which the presently claimed wafer may be at least somewhat transmissive, it is not obvious that the systems of Tanimoto can be used at these wavelengths. For example, wafers include a variety of structures that are formed during the production of semiconductor devices on the wafers. Such structures include, but are not limited to, doped structures, organic layers or structures, conductive layers or structures, semiconductor layers or structures, and insulating layers or structures. All of these structures will alter the amount of light that can be transmitted through the wafer due to reflection, refraction, diffraction, and absorption caused by the structures. For instance, most wafers are doped for semiconductor fabrication, and these dopants will absorb a large quantity of infrared light thereby rendering the wafer opaque to light in the infrared wavelength regime.

In addition, even if the wafer includes no structures that will interfere with the transmission of infrared light through the wafer, it is still not obvious that the systems of Tanimoto will be operable using this light. For instance, even if the wafer and all structures on the wafer are at least somewhat transmissive in the infrared regime, it is not obvious that enough light will be transmitted through the wafer such that the light scattered by a defect on the back side of the wafer could be differentiated from the light that is transmitted through non-defective portions of the wafer. In particular, since the infrared light transmitted through the wafer will have a relatively low intensity, particularly in comparison to the amount of light that will be transmitted through a glass substrate as described by Tanimoto, the signals detected by light-receiving portion B may not have a high enough signal-to-noise ratio to be usable for detect detection. In other words, since the teachings of Tanimoto are in reference to measurements performed on a glass substrate, it is not obvious that the prior art systems can be used for measurements of wafers using infrared light.

Furthermore, as is known to one of ordinary skill in the art, infrared light poses significant challenges to an optical tool designer that wavelengths in other wavelength regimes do not. In particular, optical components suitable for use in non-infrared wavelength measurements may not be suitable for measurements in the infrared regime. In one example,

detectors suitable for use in non-infrared systems may not be suitable for use in infrared regimes. In addition, as described above, a wafer may have substantially different effects on infrared light than a glass substrate. Therefore, since Tanimoto describes using the prior art systems for glass substrates or substrates of similar transparency and since Tanimoto does not disclose that the prior art systems can be used in the infrared wavelength regime, it is not obvious that the systems of Tanimoto can be used in the infrared wavelength regime or for defect detection on two opposing sides of the presently claimed wafer. In particular, it is not obvious that the systems of Tanimoto can be used in the infrared wavelength regime without a substantial reconstruction and redesign of the elements of the system. As a result, since the presently claimed wafer is inherently opaque to light of other non-infrared wavelength regimes, it is not obvious that the systems of Tanimoto can detect defects on two sides of the presently claimed wafer.

For at least the reasons set forth above, therefore, there is no reasonable expectation of success for using the systems of Tanimoto, modified or not, to detect defects on two sides of the presently claimed wafer. As such, the prior art cannot be modified to reject the present claims as *prima facie* obvious. The prior art can be modified or combined to reject claims as *prima facie* obvious as long as there is a reasonable expectation of success. *In re Merck & Co., Inc.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). MPEP 2143.02.

2. The Examiner has Failed to Adequately Support and/or Establish a *Prima Facie* Case of Obviousness.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all claim limitations. MPEP § 2143. These three criteria have not been met by the Examiner in the present case. For example, there is no reasonable expectation of success for modifying Tanimoto to achieve the systems and methods as recited in claims 1413, 1500, 1583, and 1688, as

explained above in Argument 1. Therefore, a *prima facie* case of obviousness has not been established.

Conclusion

As explained in the above Arguments, there is no teaching, suggestion, or motivation to modify the cited art to teach the limitations of claims 1413, 1500, 1583, and 1688. For at least these reasons, claims 1413, 1500, 1583, and 1688 are patentably distinct over the cited art. Claims 1414, 1417-1420, 1424, 1433, 1437-1438, 1443, and 1450 are dependent from claim 1413, and therefore are also patentably distinct over the cited art. The rejection of Group I claims 1413-1414, 1417-1420, 1424, 1433, 1437-1438, 1443, 1450, 1500, 1583, and 1688 under 35 U.S.C. 103 is, therefore, asserted to be erroneous.

B. Patentability of Group II Claims 1415-1416

Because claims 1415-1416 of Group II are dependent from claim 1413 of Group I, the arguments presented above for patentability of claim 1413 apply equally to claims 1415-1416, and are herein incorporated by reference. Claim 1413 recites that the system includes a stage configured to support the specimen during use. Claim 1415 further recites that the claimed stage is configured to move rotatably during use. Claim 1416 further recites that the claimed stage is configured to move laterally and rotatably during use. These additional recitations make claims 1415-1416 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a stage that is configured to move rotatably during use.

Maris and Tanimoto teach a stage that is configured to move laterally. However, neither Maris nor Tanimoto teaches, suggests, or provides motivation for a stage that is configured to move rotatably during use. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge

generally available to one of ordinary skill in the art. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). MPEP 2143.01. In addition, there is no teaching, suggestion or motivation to modify the cited art to teach the above limitations of claims 1415-1416, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1415-1416 are therefore patentable over the cited art, and rejection of claims 1415-1416 under 35 U.S.C. § 103 is asserted to be erroneous.

C. <u>Patentability of Group VII Claim 1436</u>

Because claim 1436 of Group VII is dependent from claim 1413 of Group I, the arguments presented above for patentability of claim 1413 apply equally to claim 1436, and are herein incorporated by reference. Claim 1413 recites that the system includes a measurement device. Claim 1436 further recites that the claimed measurement device includes a beam profile ellipsometer. This additional recitation makes claim 1436 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a measurement device that includes a beam profile ellipsometer.

Maris teaches a measurement device that can be used to perform a number of measurements including ellipsometry and reflectometry measurements. Tanimoto teaches a measurement device that detects defects based on scattered light. However, Maris and Tanimoto do not teach, suggest, or provide motivation for a measurement device that includes a beam profile ellipsometer. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include a beam profile ellipsometer, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1436 is therefore patentable over the cited art, and rejection of claim 1436 under 35 U.S.C. § 103 is asserted to be erroneous.

D. Patentability of Group X Claim 1451

Because claim 1451 of Group X is dependent from claim 1413 of Group I, the arguments presented above for patentability of claim 1413 apply equally to claim 1451, and are herein incorporated by reference. Claim 1413 recites that the claimed measurement device includes a detection system. Claim 1451 further recites that the claimed detection system is configured to detect energy propagating from multiple locations on the surface of the specimen substantially simultaneously such that the at least three properties of the specimen at the multiple locations can be determined substantially simultaneously. These additional recitations of claim 1451 make claim 1451 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a detection system configured to detect energy propagating from multiple locations on the surface of a specimen substantially simultaneously such that the at least three properties of the specimen at the multiple locations can be determined substantially simultaneously.

Maris teaches that a pump beam and a probe beam can be directed to different locations on a specimen. However, Maris also teaches that the prior art system detects energy propagating from only the location to which the probe beam was directed. Therefore, Maris does not teach or suggest determining at least three properties of a specimen at multiple locations on a specimen substantially simultaneously. Tanimoto cannot be combined with Maris to overcome deficiencies therein. For example, Tanimoto does not teach or suggest determining multiple properties of a specimen at multiple locations substantially simultaneously. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed detection system, or to combine the cited art with any other reference to teach or suggest these limitations. Claim 1451 is therefore patentable over the cited art, and rejection of claim 1451 under 35 U.S.C. § 103 is asserted to be erroneous.

E. Patentability of Group XVII Claims 1478-1482

Because claims 1478-1482 of Group XVII are dependent from claim 1413 of Group I, the arguments presented above for patentability of claim 1413 apply equally to claims 1478-1482,

and are herein incorporated by reference. Claim 1413 recites that the system includes a processor coupled to the measurement device. Claims 1478-1482 further recite that the claimed processor is configured to generate a database that includes the claimed determined properties of the specimen. These additional recitations make claims 1478-1482 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a processor that is configured to generate a database that includes determined properties of a specimen.

Maris and Tanimoto teach a processor coupled to a measurement device. However, Maris and Tanimoto do not teach, suggest, or provide motivation for a processor that is configured to generate a database that includes determined properties of a specimen. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed processor, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1478-1482 are therefore patentable over the cited art, and rejection of claims 1478-1482 under 35 U.S.C. § 103 is asserted to be erroneous.

F. Patentability of Group XIX Claims 1487-1488

Because claims 1487-1488 of Group XIX are dependent from claim 1413 of Group I, the arguments presented above for patentability of claim 1413 apply equally to claims 1487-1488, and are herein incorporated by reference. Claims 1487-1488 further recite that the claimed system includes a stand alone system that is coupled to the system and is configured to be calibrated with a calibration standard during use and to calibrate the claimed system during use. These additional recitations make claims 1487-1488 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a system that includes a stand alone system that is coupled to the system and is configured to be calibrated with a calibration standard during use and to calibrate the claimed system during use.

Maris and Tanimoto teach methods for calibrating the prior art systems. However, Maris and Tanimoto do not teach, suggest, or provide motivation for a system that includes a stand alone system that is coupled to the system and is configured to be calibrated with a calibration standard during use and to calibrate the claimed system during use. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed stand alone system, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1487-1488 are therefore patentable over the cited art, and rejection of claims 1487-1488 under 35 U.S.C. § 103 is asserted to be erroneous.

ISSUE 2 ARGUMENTS

A. Patentability of Group III Claims 1421-1423

Because claims 1421-1423 of Group III are dependent from claim 1413 of Group I, the Issue 1 arguments presented above for patentability of claim 1413 apply equally to claims 1421-1423, and are herein incorporated by reference. Claim 1421 further recites that the claimed measurement device includes a non-imaging scatterometer. Claim 1422 further recites that the claimed measurement device includes a scatterometer. Claim 1423 further recites that the claimed measurement device includes a spectroscopic scatterometer. These additional recitations make claims 1421-1423 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a measurement device that includes a non-imaging scatterometer, a scatterometer, or a spectroscopic scatterometer.

Tanimoto teaches a measurement device that detects defects based on scattered light. However, the scattered light based system of Tanimoto is not configured as a scatterometer. In addition, Maris, Tanimoto, Moore, and Kuriyama do not teach, suggest, or provide motivation for a measurement device that includes a non-imaging scatterometer, a scatterometer, or a spectroscopic scatterometer. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include a non-imaging scatterometer, a scatterometer, or a spectroscopic

scatterometer, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1421-1423 are therefore patentable over the cited art, and rejection of claims 1421-1423 under 35 U.S.C. § 103 is asserted to be erroneous.

B. Patentability of Group IV Claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, 1497-1499, 1709, and 1751

Because claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, and 1497-1499 of Group IV are dependent from claim 1413 of Group I, the Issue 1 arguments presented above for the patentability of Group I apply equally to claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, and 1497-1499, and are herein incorporated by reference.

The cited art does not teach or suggest a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer.

As discussed above in the Issue 1 arguments with respect to the patentability of Group I claims 1413-1414, 1417-1420, 1424, 1433, 1437-1438, 1443, 1450, 1500, 1583, and 1688, Maris and Tanimoto, individually and in combination, do not teach, suggest, or provide motivation for a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer. Independent claims 1709 and 1751 recite similar limitations. Therefore, Maris and Tanimoto do not teach or suggest all limitations of claims 1709 and 1751.

Moore and Kuriyama cannot be combined with Maris and Tanimoto to overcome deficiencies therein. For example, Moore discloses a cluster tool layer thickness measurement apparatus. Moore states that "This invention related generally to determining the quality of layers deposited on a substrate and in particular to measuring the thickness of a layer deposited on a substrate." (Moore -- col. 1, lines 7-9). Therefore, Moore teaches measuring a thickness of a layer on a substrate. However, Moore does not teach or suggest a system configured to

determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer, as recited in claims 1413, 1709, and 1751. Consequently, Moore cannot be combined with Maris and Tanimoto to overcome deficiencies therein.

Kuriyama discloses an apparatus for detecting faults on the surface of a resist master disc and measuring the thickness of the resist coating layer. For example, Kuriyama states that "it is necessary, in the process of producing the master disc, to detect the presence of faults such as dust, defects, or flaws on the surface of the master disc which may cause a drop out." (Kuriyama -- col. 1, lines 33-38). Therefore, Kuriyama discloses detecting defects on an upper surface of a master disc. However, Kuriyama does not teach or suggest a system configured to determine at least three properties of a wafer that include a presence of macro defects on a back side of the wafer and a presence of micro or macro defects on a front side of the wafer, as recited in claims 1413, 1709, and 1751. Consequently, Kuriyama cannot be combined with Maris, Tanimoto, and Moore to overcome the deficiencies therein.

Conclusion

As explained in the above Arguments, the limitations of claims 1413, 1709, and 1751 are not taught or suggested by the cited art. Furthermore, there is no teaching, suggestion or motivation to modify the cited art to teach or suggest these claim limitations. For at least these reasons, claims 1413, 1709, and 1751 are patentably distinct over the cited art. Claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, and 1497-1499 are dependent from claim 1413, and therefore are also patentably distinct over the cited art. The rejection of Group IV claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, 1497-1499, 1709, and 1751 under 35 U.S.C. 103 is, therefore, asserted to be erroneous.

C. Patentability of Group V Claim 1426

Because claim 1426 of Group V is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1426, and are herein incorporated by reference. Claim 1426 further recites that the claimed measurement device includes a coherence probe microscope. This additional recitation makes claim 1426 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a measurement device that includes a coherence probe microscope.

As described above in the Issue 1 arguments for patentability of Group VII claim 1436, Maris and Tanimoto describe measurement devices configured to perform different types of measurements. In addition, Moore and Kuriyama also teach measurement devices configured to perform different types of measurements. However, Maris, Tanimoto, Moore, and Kuriyama do not teach, suggest, or provide motivation for a measurement device that includes a coherence probe microscope. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include a coherence probe microscope, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1426 is therefore patentable over the cited art, and rejection of claim 1426 under 35 U.S.C. § 103 is asserted to be erroneous.

D. Patentability of Group VI Claim 1435

Because claim 1435 of Group VI is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1435, and are herein incorporated by reference. Claim 1435 further recites that the claimed measurement device includes a dual beam spectrophotometer. This additional recitation makes claim 1435 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a measurement device that includes a dual beam spectrophotometer.

As described above in the arguments for patentability of Group V claim 1426, Maris, Tanimoto, Moore, and Kuriyama describe measurement devices configured to perform different types of measurements. However, Maris, Tanimoto, Moore, and Kuriyama do not teach, suggest, or provide motivation for a measurement device that includes a dual beam spectrophotometer. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include a dual beam spectrophotometer, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1435 is therefore patentable over the cited art, and rejection of claim 1435 under 35 U.S.C. § 103 is asserted to be erroneous.

E. Patentability of Group VIII Claim 1442

Because claim 1442 of Group VIII is dependent from claim 1413 of Group I, the Issue 1 arguments presented above for patentability of claim 1413 apply equally to claim 1442, and are herein incorporated by reference. Claim 1442 further recites that the macro defects include copper contamination. This additional recitation makes claim 1442 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a system configured to determine at least three properties of a wafer that include a presence of macro defects, which include copper contamination, on the back side of the wafer.

As discussed above with respect to the patentability of Group IV claims 1425, 1427-1432, 1434, 1439, 1441, 1444-1445, 1447, 1452-1455, 1459, 1461-1465, 1475-1477, 1490-1495, 1497-1499, 1709, and 1751, the cited art does not teach, suggest, or provide motivation for a system configured to determine a presence of defects on the back side of a wafer. As such, there can be no teaching, suggestion or motivation to modify the prior art systems such that they are configured to determine a presence of macro defects, which include copper contamination, on the back side of a wafer, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1442 is therefore patentable over the cited art, and rejection of claim 1442 under 35 U.S.C. § 103 is asserted to be erroneous.

F. **Patentability of Group IX Claims 1448-1449**

Because claims 1448-1449 of Group IX are dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claims 1448-1449, and are herein incorporated by reference. Claims 1448-1449 further recite that the claimed measurement device includes at least an eddy current device. This additional recitation makes claims 1448-1449 separately patentable over the cited art, as described in more detail below.

The cited art does not teach, suggest, or provide motivation for a measurement device that includes an eddy current device.

As described above in the arguments for patentability of Group V claim 1426, Maris, Tanimoto, Moore, and Kuriyama describe measurement devices configured to perform different types of measurements. However, Maris, Tanimoto, Moore, and Kuriyama do not teach, suggest, or provide motivation for a measurement device that includes an eddy current device. In addition, there is no teaching, suggestion or motivation to modify the prior art systems to include an eddy current device, or to combine the cited art with any other reference to teach or suggest this limitation. Claims 1448-1449 are therefore patentable over the cited art, and rejection of claims 1448-1449 under 35 U.S.C. § 103 is asserted to be erroneous.

G. **Patentability of Group XI Claims 1456-1457**

Because claims 1456-1457 of Group XI are dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claims 1456-1457, and are herein incorporated by reference. Claim 1456 further recites that the claimed stage is configured to move the specimen from the claimed system to a process tool coupled to the system during use. Claim 1457 further recites that the claimed stage is configured to move the specimen to a process chamber of a process tool coupled to the claimed system during use. These additional recitations of claims 1456-1457 make claims 1456-1457 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a stage configured to move a specimen from a system to a process tool or a process chamber of a process tool coupled to the system.

Moore teaches a measurement apparatus coupled to a cluster tool. Moore states that "robot 104 removes the substrate from the reaction chamber of reactor 120 and places the substrate on a substrate support 220 in cluster tool layer thickness measurement apparatus." (Moore -- col. 3, lines 5-8). However, Moore does not teach or suggest that substrate support 220 moves the substrate from the measurement apparatus to the cluster tool or a reaction chamber of the cluster tool. Therefore, Moore does not teach or suggest a stage configured to move a specimen from a system to a process tool or a process chamber of a process tool coupled to the system. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest a process tool coupled to a system. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed stage, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1456-1457 are therefore patentable over the cited art, and rejection of claims 1456-1457 under 35 U.S.C. § 103 is asserted to be erroneous.

II. <u>Patentability of Group XII Claim 1458</u>

Because claim 1458 of Group XII is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1458, and are herein incorporated by reference. Claim 1458 further recites that the claimed system is configured to determine at least the three properties of the specimen while the specimen is waiting between process steps. This additional recitation of claim 1458 makes claim 1458 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a system configured to determine at least three properties of a specimen while the specimen is waiting between process steps.

Moore teaches a measurement apparatus coupled to a cluster tool. However, Moore does not teach or suggest a system configured to determine at least three properties of a specimen while the specimen is waiting between process steps. Instead, Moore simply teaches measuring a property of a substrate between process steps. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest a process tool coupled to a system. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include this limitation, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1458 is therefore patentable over the cited art, and rejection of claim 1458 under 35 U.S.C. § 103 is asserted to be erroneous.

I. <u>Patentability of Group XIII Claim 1460</u>

Because claim 1460 of Group XIII is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1460, and are herein incorporated by reference. Claim 1460 further recites that the claimed system is coupled to a process tool that includes a support device configured to support the specimen during a process step, where an upper surface of the claimed stage is angled with respect to an upper surface of the support device. This additional recitation of claim 1460 makes claim 1460 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a system coupled to a process tool that includes a support device configured to support a specimen during a process step, where an upper surface of a stage of the system is angled with respect to an upper surface of the support device.

Moore teaches a measurement apparatus coupled to a cluster tool. However, Moore does not teach or suggest a system coupled to a process tool that includes a support device configured to support a specimen during a process step, where an upper surface of a stage of the system is angled with respect to an upper surface of the support device. For instance, as shown in Fig. 2 of Moore, substrate support 220 is not angled with respect to the support devices included in reactors 110, 120, and 130. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest

a process tool coupled to a system. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed stage, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1460 is therefore patentable over the cited art, and rejection of claim 1460 under 35 U.S.C. § 103 is asserted to be erroneous.

J. Patentability of Group XIV Claims 1466-1469

Because claims 1466-1469 of Group XIV are dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claims 1466-1469, and are herein incorporated by reference. Claims 1466-1469 further recite that the claimed stage is disposed within a process chamber of a process tool and is configured to support the specimen during a process step. These additional recitations of claims 1466-1469 make claims 1466-1469 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a system that is configured to determine at least three properties of a specimen that includes a stage that is disposed within a process chamber of a process tool and is configured to support the specimen during a process step.

Moore teaches a measurement apparatus coupled to a cluster tool. Moore states that "substrate support 220, moves the substrate under an optical thickness measurement assembly 230." (Moore -- col. 3, lines 10-11). However, Moore does not teach or suggest that substrate support 220 is disposed within a reactor of the cluster tool or is configured to support the specimen during a process step. Therefore, Moore does not teach or suggest a stage that is disposed within a process chamber of a process tool and is configured to support the specimen during a process step. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest a process tool coupled to a system. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed stage, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1466-1469 are therefore

patentable over the cited art, and rejection of claims 1466-1469 under 35 U.S.C. § 103 is asserted to be erroneous.

K. Patentability of Group XV Claims 1470-1471

Because claims 1470-1471 of Group XV are dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claims 1470-1471, and are herein incorporated by reference. Claims 1470-1471 further recite that the claimed stage is configured to move the specimen from a first process chamber of a process tool to a second process chamber of the process tool. These additional recitations of claims 1470-1471 make claims 1470-1471 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a system that is configured to determine at least three properties of a specimen that includes a stage that is configured to move the specimen from a first process chamber of a process tool to a second process chamber of the process tool.

Moore teaches a measurement apparatus coupled to a cluster tool. Moore discloses substrate support 220 that is configured to support a substrate during measurements by measurement apparatus 201. However, Moore does not teach or suggest that substrate support 220 is configured to move the substrate from one reactor to another in reactor cluster 200. Therefore, Moore does not teach or suggest a stage that is configured to move the specimen from a first process chamber of a process tool to a second process chamber of the process tool. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest a process tool coupled to a system. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed stage, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1470-1471 are therefore patentable over the cited art, and rejection of claims 1470-1471 under 35 U.S.C. § 103 is asserted to be erroneous.

L. Patentability of Group XVI Claims 1472-1474

Because claims 1472-1474 of Group XVI are dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claims 1472-1474, and are herein incorporated by reference. Claims 1472-1474 further recite that the claimed processor is configured to compare at least one of the determined properties of the specimen to properties of a plurality of specimens or to a predetermined range for the property. These additional recitations of claims 1472-1474 make claims 1472-1474 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a system that is configured to determine at least three properties of a specimen that includes a processor that is configured to compare at least one of the determined properties to properties of a plurality of specimens or to a predetermined range for the property.

Maris discloses that quantities for a material can be determined by comparison with simulated data. (Maris -- col. 20, lines 44-55). However, Maris does not teach or suggest comparing determined properties of a specimen with properties of a plurality of specimens or a predetermined range for the property. Therefore, Maris does not teach or suggest a processor that is configured to compare at least one of the determined properties to properties of a plurality of specimens or to a predetermined range for the property. In addition, Tanimoto, Moore, and Kuriyama do not teach or suggest these limitations. As such, Tanimoto, Moore, and Kuriyama cannot be combined with Maris to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include these limitations, or to combine the cited art with any other reference to teach or suggest these limitations. Claims 1472-1474 are therefore patentable over the cited art, and rejection of claims 1472-1474 under 35 U.S.C. § 103 is asserted to be erroneous.

M. Patentability of Group XVIII Claims 1483-1486

Because claims 1483-1486 of Group XVIII are dependent from claim 1413 of Group I (via claims 1478 and 1481 of Group XVII), the Issue 1 and 2 arguments presented above for

patentability of Groups 1 and XVII apply equally to claims 1483-1486, and are herein incorporated by reference. Claims 1483-1486 further recite that the claimed processor is configured to generate a database, which includes the first, second, and third properties of a plurality of specimens that are determined using a plurality of measurement devices. The additional recitation of claims 1483-1486 makes claims 1483-1486 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a processor that is configured to generate a database, which includes the first, second, and third properties of a plurality of specimens that are determined using a plurality of measurement devices.

Maris teaches processor 66 coupled to detector 60, as shown in Fig. 2 of Maris. However, Maris does not teach or suggest that this or any other processor is configured to generate a database. In addition, Tanimoto, Moore, and Kuriyama do not teach or suggest a processor that is configured to generate a database. As such, Maris, Tanimoto, Moore, and Kuriyama cannot teach or suggest a processor that is configured to generate a database, which includes the first, second, and third properties of a plurality of specimens that are determined using a plurality of measurement devices. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed processor, or to combine the cited art with any other reference to teach or suggest this limitation. Claims 1483-1486 are therefore patentable over the cited art, and rejection of claims 1483-1486 under 35 U.S.C. § 103 is asserted to be erroneous.

N. Patentability of Group XX Claim 1489

Because claim 1489 of Group XX is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1489, and are herein incorporated by reference. Claim 1489 further recites that the claimed processor is configured to alter at least one parameter of one or more instruments coupled to a process tool in response to at least one of the determined properties of the specimen at more than one position on the specimen to reduce within wafer variation of at least one of the determined properties.

The additional recitation of claim 1489 makes claim 1489 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a processor that is configured to alter at least one parameter of one or more instruments coupled to a process tool in response to at least one determined property of a specimen at more than one position on the specimen to reduce within wafer variation of at least one of the determined properties.

Moore states that "the data can be used to adjust process parameters for any one or all of reactors 110, 120 and 130, and can be used to automatically adjust or stop the operation of apparatus 201." (Moore -- col. 3, lines 31-34). However, Moore does not teach or suggest altering a parameter of one or more instruments coupled to the cluster tool to reduce within wafer variation of at least one determined property of a specimen. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest altering a parameter of one or more instruments coupled to a process tool to reduce within wafer variation of at least one determined property of a specimen. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed processor, or to combine the cited art with any other reference to teach or suggest this limitation. Claim 1489 is therefore patentable over the cited art, and rejection of claim 1489 under 35 U.S.C. § 103 is asserted to be erroneous.

O. Patentability of Group XXI Claim 1496

Because claim 1496 of Group XXI is dependent from claim 1413 of Group I, the Issue 1 and 2 arguments presented above for patentability of claim 1413 apply equally to claim 1496, and are herein incorporated by reference. Claim 1496 further recites that the claimed processor is coupled to a plurality of measurement devices and that each of the plurality of measurement devices is coupled to at least one of a plurality of process tools. These additional recitations of claim 1496 make claim 1496 separately patentable over the cited art, as described in more detail below.

The cited art does not teach or suggest a processor coupled to a plurality of measurement devices, each of which is coupled to at least one of a plurality of process tools.

Moore teaches a measurement apparatus coupled to a cluster tool. However, Moore does not teach or suggest a plurality of measurement devices, each of which is coupled to at least one of a plurality of process tools. In addition, Maris, Tanimoto, and Kuriyama do not teach or suggest a measurement device that is coupled to a process tool. As such, Maris, Tanimoto, and Kuriyama cannot be combined with Moore to overcome deficiencies therein. Furthermore, there is no teaching, suggestion or motivation to modify the prior art systems to include the claimed processor or the claimed plurality of measurement devices, or to combine the cited art with any other reference to teach or suggest these limitations. Claim 1496 is therefore patentable over the cited art, and rejection of claim 1496 under 35 U.S.C. § 103 is asserted to be erroneous.

IX. CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejection of claims 1413-1439, 1441-1445, 1447-1500, 1583, 1688, 1709, and 1751 was erroneous, and reversal of the Examiner's decision is respectfully requested.

The Commissioner is hereby authorized to charge the required fee(s) to Daffer McDaniel LLP Deposit Account No. 50-3268/5589-02305.

Respectfully submitted,

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Date: December 1, 2004